REMARKS

In an Official Action dated October 24, 2008, the Examiner again rejected claims 1-8 as anticipated Nippert 6,651,545 and claims 9-10 as obvious over Nippert '545 in combination with Salter 5,259,738. Applicants request that the Examiner reconsider the rejections in light of the following discussion.

Applicants believe that the apparatus of Nippert is sufficiently different from Applicants' system as claimed and from that of Jokela that it would not be obvious to apply the control system of Jokela to the apparatus of Nippert.

The Examiner states that the device of Nippert features a controller which is arranged to select the mode of each chamber on successive cycles so as to vary the time averaged effective flow rate of fluid through the machine. However, Nippert does not mention that the control mode of each cylinder is operated in a sequence such as to produce a time-averaged effective flowrate. There is no indication that Nippert conceived of controlling the device by alternating partial pumping strokes with "locked" strokes.

The Examiner states that because the speed of the shaft is continuously measured, the output of the pump can be continuously controlled. However, that is not correct. The speed measured by the sensor is not a measure of the output of the pump, so the fact that the speed is continuously measured does not mean that Nippert intended to continuously control the output of the pump.

The Examiner states that it would be obvious for one of ordinary skill in the art to use the control system described by Jokela et al in the apparatus of Nippert. However, due to the substantial difference of the apparatus of the Jokela and Nippert devices, it is not possible to usefully apply the control system of Jokela to the apparatus of Nippert. Firstly, the control system of Jokela provides only one valve control output per working chamber as it has only to actuate one valve per revolution to achieve a pumping cycle

(the other valve being a passive check valve), whereas the apparatus of Nippert requires two valves to be controlled in a phased relationship to achieve the same end. Secondly, the control system of Jokela cannot take an input from an operator as to the desired direction of flow, only the desired magnitude – the apparatus of Jokela restricts flow to only one direction as there is one manifold at low pressure from which the pump must intake and one manifold at high pressure into which the pump must deliver. By contrast, the device of Nippert is bi-directional as it is desired for instance to move the cylinder (18) in both directions. Therefore the controller of Nippert must act to sequence the two commutating valves in the correct sequence according to the desired flow direction. Therefore the control system of Jokela could not by usefully applied to the apparatus of Nippert.

Additionally, even if the features of Jokela and Nippert are combined, the combination does not teach or suggest the features of Applicant's system. The control system of Jokela operates the working chamber in one of two modes: full strokes and idle strokes. There is no mention by Jokela of the possibility that the device could be controlled to deliver partial strokes. No motivation is given for why this would be desirable, and there is no description of how this would affect the design of the control system. By contrast, Applicant's device operates the working chambers in one of three modes in the case of a pump (idle, partial stroke and full strokes) and five modes in the case of a pump/motor as per Claim 3 (idle, partial stroke pump, partial stroke motor, full stroke pump, full stroke motor).

The problem solved by the control system of Jokela is providing a constant pressure output (col 8, line 29) using working chambers which can only carry out idle or full pumping cycles. Jokela does not mention the issue of the large amount of fluid pulsation which is experienced by the load when the displacement of his device is very low. In this condition, the output of the device of Jokela consists of occasional full strokes and is therefore highly pulsatile.

Surprisingly, the Applicants have found that the pulsatile delivery of flow due to interpersing full strokes with idles strokes at low flow rates is a severe drawback when the pump is delivering fluid to a motor which propels a vehicle, due to the high degree of pressure pulsation which results (see page 3 lines 4-20 of the present application).

Also surprisingly, the Applicants have found that the speed of the vehicle is unstable and inconsistent when very small partial strokes are produced by the pump. This due to the inconsistency of the transit time of each of the low pressure commutating valves from the start of the solenoid pulse to the actual event at which the valve finished closing (in other words, the stability of valve operation, as mentioned at page 4 lines 25 to 26 of the present application), the variability of this time from one nominally identical valve to another in a multi-cylinder pump, and the increased pressure sensitivity of very small partial strokes due to the finite fluid compliance of the dead volume within the working chamber

Although these problems are described above in terms of vehicle propulsion applications as an example, the applicant has found that these same problems of pulsation and unstable speed apply in other applications, including controlling the movement of a boom actuated by a hydraulic cylinder.

Also surprisingly, the applicants found that by selecting the mode of each chamber (from those of idle, partial and full stroke) on successive cycles, these problems were overcome. Particularly, instead of operating working chambers with very small partial strokes on every working stroke, the applicants surprisingly found that interspersing larger partial strokes with idle strokes in a sequence could achieve stable, consistent control of vehicle (or boom) speed, with acceptable pulsation, when a hydraulically-propelled vehicle (or hydraulically-actuated boom) is operated at low speed.

The Examiner states with the benefit of hindsight that it would be obvious to

combine partial strokes with idle strokes in a sequence. However, until Applicants made their experimental investigations, there would have been no motivation to do this. There was no awareness in the prior art of the need for partial strokes to achieve low pulsation when propelling a vehicle, nor of the drawbacks of continuous very small partial strokes which are detailed above. There was no suggestion by Nippert, Jokela or any other of the prior art that combining partial strokes with idle strokes in a sequence would achieve the surprising and unpredictable result that the applicants achieved.

In light of the foregoing, Applicant believes this case is in form for allowance. If the Examiner believes that any issues remain regarding the allowability of the application, the Examiner is requested to contact Applicants' undersigned attorney to rectify any outstanding issues.

Respectfully submitted,

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